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Minimum wages and employment in China

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Abstract

Since China promulgated new minimum wage regulations in 2004, the frequency and magnitude of changes in minimum wages have been substantial. This paper uses county-level minimum wage data combined with urban household survey micro-dataset from 16 representative provinces as a merged county-level panel to estimate the employment effects of minimum wage changes in China over the 2002–2009 period. In contrast to the mixed results reported by previous studies using provincial-level data, we present evidence that minimum wage changes led to significant adverse effects on employment in the Eastern and Central regions of China, and resulted in disemployment for females, young adults, and low-skilled workers.

JEL classifications: J38

Keywords: Minimum wage; China; Employment

1 Introduction

Since China enacted its new minimum wage regulations in 2004, minimum wages have sparked intense debate in the country. In China, supporters of minimum wages advocate them as a way to assist individuals or families to achieve self-sufficiency and to protect workers in low-paid occupations (Zhang and Deng 2005; Sun 2006). Minimum wages can help reduce inequality by providing a wage floor (Zhang 2007; Jia and Zhang 2013). In addition, higher labor cost may promote managerial efficiency and labor productivity, inducing employers to invest in productivity-improving technology (Cooke 2005). Along these lines, many Chinese scholars have argued in favor of the more proactive increase of minimum wages (Du and Wang 2008; Ding 2009; Han and Wei 2011).

On the other hand, opponents argue that raising the minimum wage can decrease the employment opportunities of low-wage workers and also lead to reduction in other components of the compensation package (Xue 2004; Ping 2005; Gong 2009). Such regulations can undermine enterprises' dividend policies and reduce China's comparative advantage in the abundance of low-wage labor (Cheung 2004, 2010). For example, rural–urban migrants (estimated 168 million workers in 2014 by the National Health and Family Planning Commission) usually have very low pay and tend to work in the uncovered sectors (Chan 2001; Ye 2005).[1]

The minimum wage policy is contentious also because its effects on employment cannot be easily estimated. However, in recently years the new policy in China has generated a lot of variation that is useful in identifying the effects of minimum wages. Since January 2004, China promulgated new minimum wage regulations that required

local governments to introduce a minimum wage increase at least once every two years, extended coverage to self-employed and part-time workers, and quintupled the penalties for violation or noncompliance. The new regulations were put into effect in March 2004, leading to frequent and substantial increases in minimum wages in the subsequent years. These large variations both across jurisdictions and over time facilitate our estimation of minimum wage effects on employment in China.

Figure 1 shows the nominal and real minimum wage (monthly average) in China from 1995 to 2012 as well as those corresponding to the provinces that raised the minimum wages for each year, along with its moving average over the same period.[2] Between 1995 and 2003, the average nominal minimum wage increased steadily from 169 RMB to 301 RMB, amounting to a 78% growth in 9 years. However, since China implemented the new minimum wage regulations in 2004, the nominal minimum wage has increased even more rapidly by over 200%, reaching 944 RMB in 2012.[3] The real minimum wage grew at a slower pace before 2004 and began to rise thereafter. In particular, Fig. 2 shows the minimum-to-average wage ratio started to increase in 2004 for the three regions and the whole country, implying that the 2004 policy has induced an increase in the bite of the minimum wage. Furthermore, as shown by the moving average curve in Fig. 1, there is an apparent rise after 2004 in the number of provinces that raised the minimum wage standards, indicating that minimum wage adjustments had become more frequent after that year.

How did this regulatory environment affect labor market outcomes in China? More specifically, did changes in the minimum wage have any impact on employment in the Chinese labor market? Although there is an enormous literature documenting numerous aspects of minimum wages and their role in the labor market, most studies have been conducted in the high-income economies such as the U.S., U.K., and Canada; even there, no consensus has been reached on the magnitude of an effect of minimum wages on employment.[4]

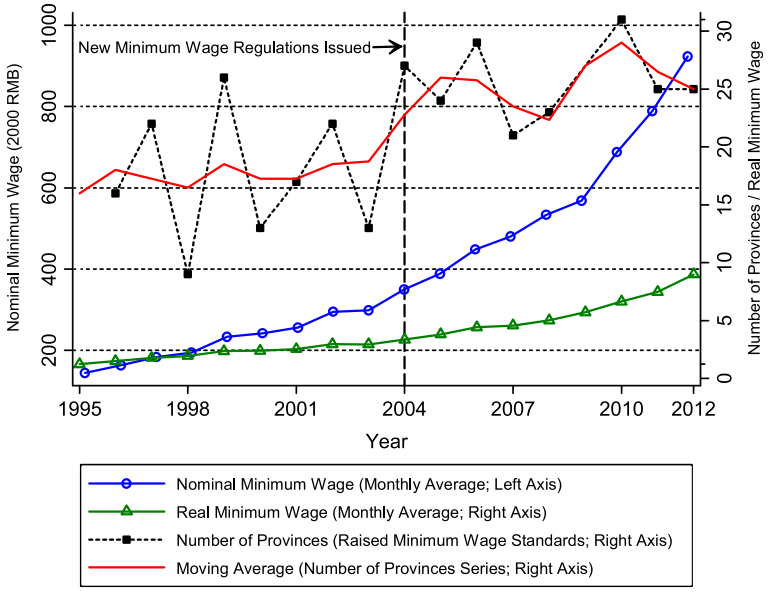

Fig. 1 Minimum wages in China, 1995–2012. Nominal minimum wages have been adjusted for inflation and expressed in 2000 RMB

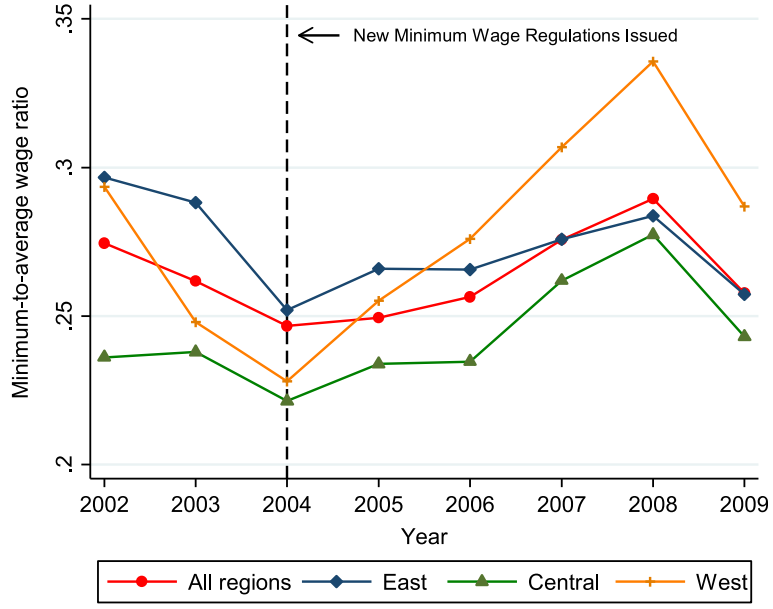

Fig. 2 Minimum-to-average wage ratios in China, by region. The East includes Liaoning, Beijing, Shandong, Jiangsu, Shanghai, and Guangdong; the Central region includes Heilongjiang, Shanxi, Henan, Anhui, Hubei, and Jiangxi; and the West includes Gansu, Chongqing, Sichuan, and Yunnan

This paper represents the first paper using county-level minimum wages merged with urban household survey microdata in China. Empirically speaking, there are at least three challenges involved in measuring the employment effects of Chinese minimum wages. First, provinces, municipalities, and autonomous regions[5] in China have considerable autonomy and flexibility in setting their minimum wages according to local conditions. There are often at least 3 or 4 levels of minimum wage standards applicable to various counties in most provinces. The fact that each county is responsible for selecting its own minimum wage standards implies that the county- or city-level minimum wage data containing the relevant information on the dates and the extent of minimum wage increases are not readily available.[6] Second, omission and endogeneity of important variables (such as the timing of decisions to adjust minimum wage standards) make it difficult to separate causal effects from effects due to other unobserved confounding factors.[7] Third, in China, it remains difficult to find microdata that can be both plausibly representative of the population and also influenced by minimum wage increases. Furthermore, some provinces, such as Beijing and Shanghai, do not include social security payments and housing provident funds as part of wages as part of the minimum wages. In effect, their actual minimum wages are higher on a comparable basis.[8]

In this paper, we first assess whether and the extent to which minimum wage changes affected the Chinese labor market by measuring the effect of the minimum wage on employment. To do so, we begin by analyzing the labor market responses to changes in minimum wage standards using panel data regressions. The most distinctive feature of our data—crucial for our research design—is the combination of a large county-level panel data of minimum wages, which covers all counties (over 2000 counties each year) in China, with a urban household survey micro-dataset of 16 representative provinces between 2002 and 2009.[9] We use the urban household surveys to construct the county-

level variables and then merge the constructed county-level data with the county-level minimum wage data. The use of county-level data rather than provincial level data allows for a more accurate measurement of the relevant minimum wage and labor market conditions, providing more variation in detecting the effects of minimum wages on employment in China. In particular, we also attempt to evaluate the effects on subgroups of the population, especially those who are at risk of being affected by a minimum wage increase, such as young adults, female and low-skilled workers.

Our regressions based on county-level panel data reveal a significant disemployment effects of minimum wages on young adults (age 15–29) between 2004 and 2009 nationwide—the estimated elasticity of the sum of current and lagged effects is −.259. Please note, for expositional convenience, we refer to the minimum wage relative to the average wage as the minimum wage in all discussion of the empirical results. Our results are reported for such normalized measure. Furthermore, we find that the previous year's minimum wage has the largest adverse effect on the employment of at-risk groups, which as defined as workers whose monthly wages are between the old and new minimum wage standards. We treated it as a simple zero–one dummy variable as the young adults group. As such the wages and employment of this at-risk group are most likely to be affected by the changes in minimum wages. As expected, the sum of the current and lagged effects yields estimated elasticities in the range of −.465 to −.552 over the same period.

Several studies on the employment effects of minimum wages in China found mixed results, and the results for different regions are often opposite to one another. For example, using provincial level data Ni et al. (2011) focused on all employees and found some negative effects in the more prosperous and rapidly growing East region, and some positive effects in the developing Central region and less developed Western regions over the 2000–2005 period. In contrast, Wang and Gunderson (2011) used 2000–2007 provincial data of rural migrants and found no adverse effects and in fact a positive employment effect in state-owned enterprises in the East and negative effects in the Central and Western regions. The discrepancies between these studies may be explained in part by the fact that the employment effects of minimum wage increases on different target groups tend to differ. By examining the effects on several subgroups, our estimates seem to be consistent with their findings—we find that, similar to Ni et al. (2011), the current minimum wage has a significantly negative effect on all employees in the East and a one-year lagged positive (though statistically insignificant) effect in the Western region in 2004–2009. In contrast, using rural migrants as the target group, we find that the current minimum wage has an adverse and significant effect in the West and a positive (though statistically insignificant) effect in the East over the same period studied in Wang and Gunderson (2011).[10]

Finally, we investigate the impact of the minimum wage on the employment of workers by skill level. In theory, low-skilled workers are relatively vulnerable to job loss when facing minimum wage increases. As anticipated, our county-level panel data analysis shows that the current minimum wage has an adverse, though perhaps mild, effect on the employment of low-skilled workers (defined as those with a high school diploma or below), the estimated elasticites of the current effect are in the range of −.054 to −.080 for the entire sample, −0.070 for the East region, and −0.070 to −0.077 for the Central region.

As a placebo test, we do not find a statistically significant effect for high-skilled workers (defined those with a college diploma or above).

2 Minimum wages in China

Prior to 1994, China had no minimum wage law. In 1984, the country started by acknowledging the 1928 "Minimum Wage Treaty" of the International Labour Organization (ILO) (Su 1993). Due to sluggish wage growth and high inflation in the late 1980s, Zhuhai in Guangdong Province first implemented its local minimum wage regulations, followed by Shenzhen, Guangzhou, and Jiangmen in 1989. It was not until the eruption of private enterprises in 1992 when labor disputes became frequent that the Chinese Central Government began to consider minimum wage legislation (Yang 2006). In 1993, China issued its first national minimum wage regulations, and in July 1994, they were written into China's new version of the Labor Law.

The 1994 legislation required that all employers pay wages no less than the local minimum wage. All provincial, autonomous-region, and municipal governments should set their minimum wages according to five principles and report them to the State Council of the Central Government. Specifically, the five principles stipulated that the setting and adjustment of the local minimum wage should synthetically consider the lowest living expenses of workers and the average number of dependents they support, local average wages, labor productivity, local employment, and levels of economic development across regions. These conditions provided considerable flexibility for provinces in setting minimum wage standards, according to economic development principles and the need to attract foreign investment (Frost 2002; Wang and Gunderson 2011). By December 1994, 7 of 31 provinces had set their own minimum wages. By the end of 1995, the number increased to 24.

In the early 2000s, the slow increase of minimum wages along with growing concerns for uncovered/disadvantaged workers prompted the Chinese government to consider new minimum wage regulations. In December 2003, the Ministry of Labour and Social Security passed "The Minimum Wage Regulations" and promulgated the new law in January 2004. The main features of this law involved extending coverage to state-owned, private enterprises, private non-enterprise units, and employees in self-employed businesses. In particular, the new law established two types of minimum wages: a monthly minimum wage applied to fulltime workers and an hourly minimum wage applied to non-fulltime workers. Importantly, the minimum wage standards were set and adjusted jointly by the local government, trade union, and enterprise confederation of each province. The draft would then be submitted to the Ministry of Labour and Social Security for review. The Ministry would then ask for opinions from the All China Federation of Trade Unions and the China Enterprise Confederation. The Ministry of Labour and Social Security can request a revision within 14 days after receiving the proposed draft. If no revision request is brought up after the 14-day period, the proposed new minimum wage program is considered to be passed.

In addition, the new regulation required local governments to renew minimum wage standards at least once every two years, and penalties for violation were increased from 20 to 100% of the owed wages to 100–500% of the owed wages.[11] Employers cannot include subsidies such as overtime pay or canteen allowances, nor travel subsidies, as

part of the wage when calculating minimum wages. The new regulations were put into effect on March 1st, 2004 and led to substantial increases in minimum wages.

3 Data and research design

The data collection and research design were motivated by an attempt to estimate the effect of minimum wages on employment and address some of the aforementioned empirical challenges. The purpose of data collection was to obtain information on the minimum wage at the county level over a long time span, with a panel structure allowing for the use of fixed time and county effects to eliminate omitted variable bias arising from unobserved variables that are constant over time and across counties. The wage sample needed to be at the individual level to allow the distribution of minimum wage workers—in each geographic region, age cohort, skill level, and industry—to be estimated. For these reasons, we sought to collect information on counties that were potentially affected over as many years as possible.

3.1 Data

Our study uses two primary data sources: the annual Urban Household Survey (UHS) from 2002 to 2009 and minimum wage data collected at the county level (6-digit code) between 1994 and 2012. The UHS is a continuous, large-scale social-economic survey conducted by the National Bureau of Statistics of China (NBS) to study the living conditions and standard of urban households, which covers agricultural and non-agricultural residents or non-residents who live in the city for at least 6 months and migrant households with local residency. Using survey sampling techniques and daily accounting methods, the UHS collects quarterly data from households in all 31 provinces of Mainland China. Starting late December, survey teams in each province and autonomous region are required to verify and then upload the aggregated annual data to the Division of City Socio-economic Survey of NBS via intranet by January 10th of the following year. The UHS contains rich arrays of household information, such as income and consumption expenditure; demographic characteristics; work and employment; housing; other family-related matters; and county identifiers (6-digit code).

Figure 3 depicts the 16 provinces (the maximum number of provinces accessible to the researchers) used to study the impact of minimum wages on the Chinese labor market. We divide the 31 jurisdictions into three regions following the NBS: the more prosperous and rapidly growing East region, the developing Central region and the less developed and more slowly growing West region. The open-door policy and economic reforms first started in the Eastern coastal regions. It is well documented (see (Cai and Wang 2005; Wang and Gunderson 2012)) that the labor market in the Eastern region is well developed and mimics a competitive labor market. As such, the external shock of a minimum wage increase with strong enforcement is expected to have significant adverse effects on employment, especially for those who are at-risk (youth, females, unskilled, migrants, etc.).

In contrast, the labor market in the Central and Western regions is relatively underdeveloped where there is still plenty supply of unskilled labor. In a developing country like China, enforcement of the minimum wage could be an important issue that affects the reliability of our results (Khamis 2013). Hence, we first examine the differences in

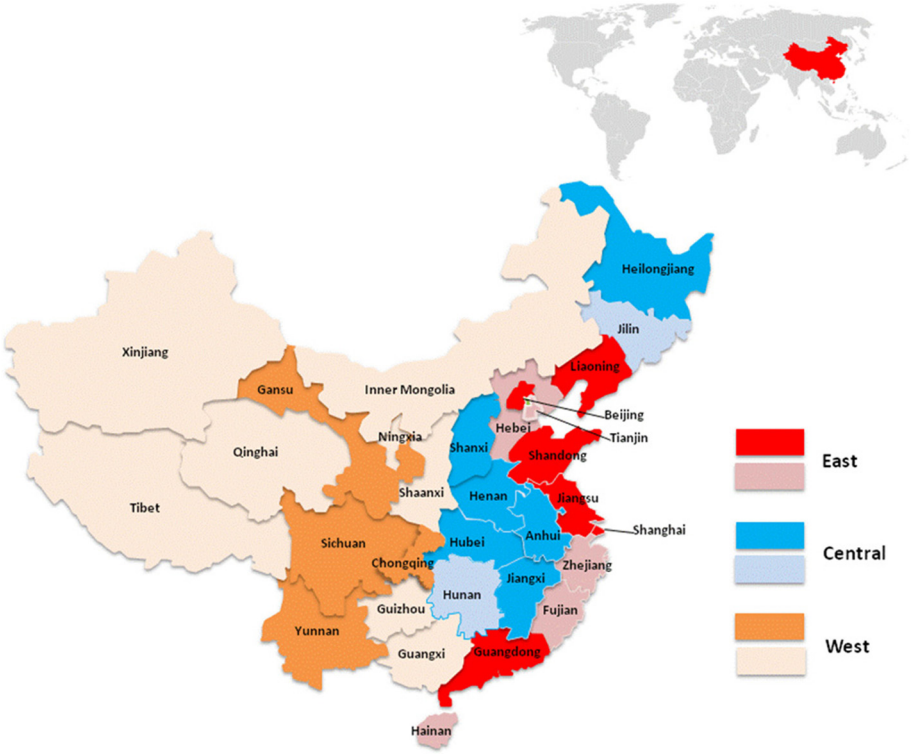

Fig. 3 Panel data with minimum wages in Mainland China. The panel data used in the analysis include 16 provinces (darker areas in the map) covering three regions in Mainland China. The East includes Liaoning, Beijing, Shandong, Jiangsu, Shanghai, and Guangdong; the Central region includes Heilongjiang, Shanxi, Henan, Anhui, Hubei, and Jiangxi; and the West includes Gansu, Chongqing, Sichuan, and Yunnan

enforcement across 16 provinces from 2002 to 2009 by constructing a measure of enforcement as the ratio of the number of workers earning almost exactly at the ongoing minimum wage (between the exact minimum wage and 1.1 times the minimum wage) divided by number of workers earning less than the minimum wage.[12] We show the ratio across provinces and over time in Fig. 4.

Figure 4 illustrates the enforcement of the minimum wage across our 16 sample provinces between 2002 and 2009. Overall, we find that enforcement increases over time in most provinces, especially after 2004 and particularly in the East part of China (Beijing, Shanghai, Jiangsu, Shandong, Guangdong and Liaoning). On the other hand, provinces in the West such as Yunnan and Sichuan as well as Henan in the Central do not show increases in enforcement over the period. Our estimated effects of the minimum wage enforcement on wages and employment (Additional file 1: Tables S3 and S4) show that the enforcement has the largest significant effect on wages and employment in the East, a relatively smaller effect in the Central, and no effect in the West. For example, the estimates of the enforcement on wages for the young adults (specification 2 in Additional file 1: Table S3) are .484 and .226 in the East and Central, respectively; for the same group, the estimates of the enforcement on employment are −.313 and −.499 in the East and Central, respectively (specification 2 in Additional file 1: Table S4).

As shown in Fig. 3, the data for the Eastern region are represented by darker areas, which include two major municipalities, Beijing and Shanghai, and four economically

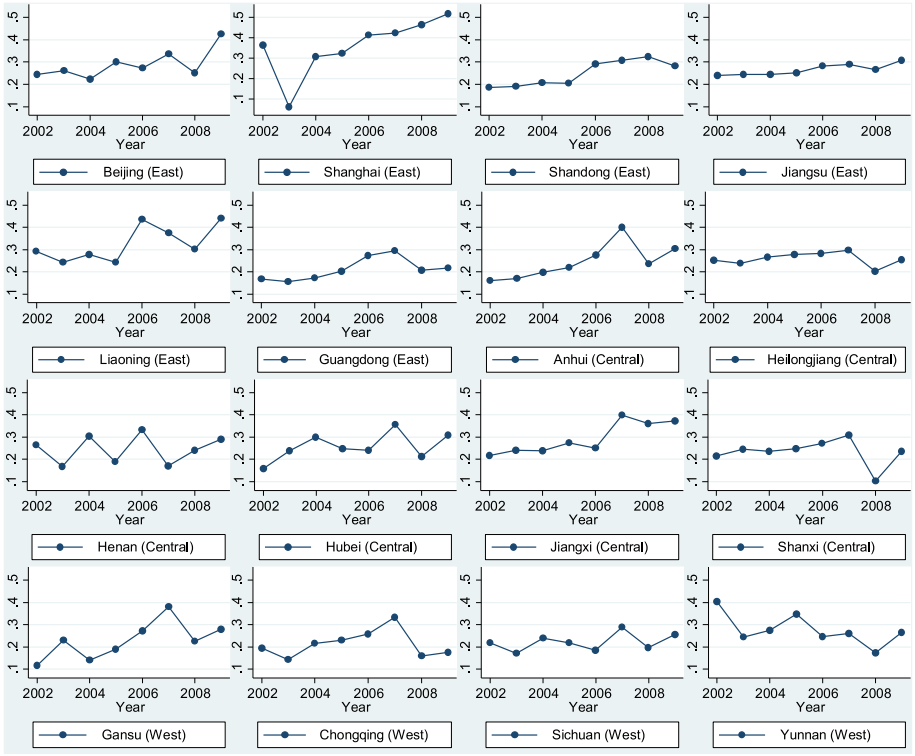

Fig. 4 Enforcement of the minimum wage across provinces, 2002–2009. The vertical axis shows enforcement, which is defined as the number of minimum wage workers divided by the number of workers earning less than the minimum wage. Minimum wage workers earn wages between the exact minimum wage and 1.1 times the minimum wage. The East includes Liaoning, Beijing, Shandong, Jiangsu, Shanghai, and Guangdong; the Central region includes Heilongjiang, Shanxi, Henan, Anhui, Hubei, and Jiangxi; and the West includes Gansu, Chongqing, Sichuan, and Yunnan

important provinces, Guangdong, Jiangsu, Shandong, and Liaoning. The Central region includes six developing provinces, namely, Henan, Anhui, Hubei, Jiangxi, and Shanxi, which are where most migrants come from. Finally, the Western region covers the one municipality, Chongqing, and three less developed provinces: Gansu, Sichuan, and Yunnan. Collectively, our 16-province sample contains 65% of the total population in China, covering 60% of the counties in the country.[13] To check the representativeness of our 16 sample provinces, we compare the descriptive statistics and some key variables from the UHS with those from the 2005 Census in Section 4.5.2. in which we show that the numbers for all 31 provinces and 16 provinces are close, indicating that the use of 16-province UHS sample is representative.

We also need to collect accurate minimum wage data for each county. As discussed, provinces in China have considerable autonomy and flexibility in setting their minimum wage standards according to local economic conditions, which creates several levels of standards across counties within the same province. Moreover, the adjustment date of a county's new minimum wage standard can also differ from its geographically contiguous neighbors within the same province, making the estimation of minimum wage effects more challenging. To effectively address this issue, we collected our own minimum wage data from every local government website and carefully recorded the minimum wage information for approximately 2,000 counties every year from 1994 to

2012. As such, our data contain monthly minimum wages for full-time employees, hourly minimum wages for part-time employees, the effective dates of the minimum wage standards and the extent to which social security payments and/or housing provident funds were included as part of the minimum wage calculations to assure that they are on a comparable basis.

We then merge the minimum wage data into the UHS, a 16-province dataset that contains individual/household socio-economic information over the 2002–2009 period. To calculate average wages, we keep only salaried workers who work for 12 months and then divide their annual wages by 12 to obtain monthly wages for each year.[14] We present a brief summary of the minimum wage data used in our main analysis for the post new minimum wage regulations (2004) period in Table 1. Columns (1), (2), and (3) correspond to the mean of the monthly minimum wages, the standard deviation, and the number of counties for the three regions as well as the 16 provinces in 2004, respectively.[15] When calculating the mean minimum wage, we use the time-weighted average method as suggested by Rama (2001).[16] The mean minimum wage has been adjusted for inflation and converted into 2005 RMB using the provincial urban resident CPI. The last row reports the mean of the minimum wages of all provinces, their standard deviations, and the total number of counties that raised minimum wages for each year.

Table 1 reveals several important patterns. First, when calculated at the county level, the mean nominal minimum wage increased by 80% (from 310 RMB to 562 RMB) between 2004 and 2009 for all counties as a whole.[17] Second, the Eastern region has the highest minimum wage, with an average of 522 RMB per month in this period, followed by the West (436 RMB) and the Central region (424 RMB). Interestingly, minimum wages of the three regions have similar annual growth rates of around 13%.[18] Third, minimum wage hikes sometimes occurred more than once in a year. For example, Beijing increased its minimum wages first in January and then July of 2004, and Jiangsu raised its standards in both April and July of 2008.

We defined employment as working-age population between the ages of 15 and 64 who are employed in the civilian labor force, report positive annual earnings, are not self-employed, and not enrolled in school. Individuals who work in agricultural production or services, farming, forestry, fishing, and ranching industries are also excluded (Neumark and Wascher 1992). Sampling weights are applied in all calculations.

Table 2 presents summary statistics for the two key variables, the minimum-to-average wage ratio and the employment-to-population ratio, from 2004 to 2009. Our population is constructed by including all persons in the same demographic group being examined. The second and third rows of the table show that male workers have approximately 10 percentage points lower minimum-to-average-wage ratios and 15 percentage points higher employment-to-population ratios than females, suggesting that Chinese female workers are comparatively disadvantaged in the labor market relative to their male counterparts.[19] As anticipated, the more prosperous Eastern region has the lowest minimum-to-average-wage ratio (.276) and the highest employment-to-population ratio (.607) among three regions.[20]

A large body of empirical evidence from minimum wage studies has consistently found that minimum wages have a greater impact on young and low-skilled workers, especially teenagers. Compared to older workers, young workers, who are often equipped with less human capital, are more likely to earn the minimum wage. Table 2

Table 1 Means and standard deviations of the minimum wage using county level information: by region and by province, 2004–2009

Province	2004			2005			2006			2007			2008			2009		
	MW	S.D.	Obs.	MW	S.D.	Obs.	MW	S.D.	Obs.	MW	S.D.	Obs.	MW	S.D.	Obs.	MW	S.D.	Obs.
East																		
Beijing	509.5	.0	2	562.5	.0	2	611.8	.0	2	665.4	.0	2	735.4	.0	2	820.1	.0	2
Shanghai	590.3	.0	2	662.5	.0	2	712.1	.0	2	757.7	.0	2	894.0	.0	2	984.2	.0	2
Liaoning	282.3	46.0	96	361.9	36.6	96	405.5	41.2	96	465.8	48.7	96	550.1	59.9	97	587.8	63.2	97
Shandong	348.4	35.2	129	440.9	50.0	129	454.6	53.5	129	476.2	66.3	129	571.9	75.6	129	609.9	80.6	129
Jiangsu	416.2	59.9	66	457.6	66.8	66	517.9	70.4	66	591.0	78.0	75	647.8	88.1	75	694.4	94.7	75
Guangdong	361.2	59.9	104	442.1	80.6	104	475.0	84.9	104	516.6	88.5	104	574.3	88.2	104	636.1	98.2	104
All East	349.1	68.5	339	426.7	72.1	399	460.6	76.0	399	507.4	86.5	408	583.6	87.6	409	629.7	95.7	409
Central																		
Heilongjiang	282.0	28.1	30	287.8	28.7	30	384.0	45.7	30	418.0	53.6	30	456.0	58.6	30	486.3	62.5	30
Anhui	304.6	11.7	86	330.7	17.1	86	350.1	19.1	86	400.7	27.1	86	420.4	29.2	86	448.3	31.2	86
Jiangxi	246.7	6.6	99	317.7	8.9	100	328.9	9.4	100	427.5	15.2	100	460.3	21.8	100	490.9	23.3	100
Shanxi	348.2	21.8	119	445.4	22.3	119	454.2	22.4	119	476.3	21.6	119	536.6	22.8	119	642.5	28.6	119
Hubei	271.9	34.9	89	320.6	36.8	89	330.2	37.2	89	402.4	39.1	89	453.4	45.6	89	541.5	58.5	89
Henan	251.5	15.5	127	278.5	17.0	127	345.0	27.9	127	371.1	25.7	127	477.2	42.5	127	509.0	45.3	127
All Central	284.8	43.6	550	337.1	63.8	551	366.2	54.7	551	416.3	46.3	551	473.1	51.7	551	529.1	77.0	551
West																		
Gansu	298.2	8.5	87	304.4	8.7	87	322.1	16.3	87	344.6	35.1	87	471.6	36.3	87	549.4	39.2	87
Chongqing	334.7	21.7	42	365.7	24.6	42	409.0	30.1	42	477.8	39.8	42	554.8	44.5	42	591.7	47.4	42
Sichuan	295.4	32.1	50	352.2	41.9	50	392.2	43.8	50	425.0	42.3	181	477.9	53.0	181	509.7	56.5	181
Yunnan	297.5	18.0	138	365.2	23.4	138	403.6	23.4	138	427.0	22.8	138	527.2	31.5	138	562.3	33.6	138
All West	302.3	23.3	317	346.5	36.1	317	380.1	45.0	317	414.9	51.8	448	499.1	52.3	448	541.3	54.1	448
All Provinces	309.5	56.7	1266	367.7	73.1	1267	399.4	73.3	1267	442.3	74.8	1407	513.5	79.2	1408	562.2	88.3	1408

MW represents the mean of time-weighted monthly minimum wages calculated using all counties in a jurisdiction, and it has been adjusted for inflation and converted into 2005 RMB

Table 2 Summary statistics, 2004–2009

Variable		Minimum/Average wage		Employment/Population	
		Mean	S.D.	Mean	S.D.
All	100.0	.291	.094	.595	.072
Gender					
Male	55.3	.256	.089	.673	.074
Female	44.7	.354	.115	.520	.087
Region					
East	54.1	.276	.099	.607	.068
Central	32.9	.298	.086	.586	.074
West	13.0	.335	.074	.572	.071
Age cohort					
Age 15–29	13.1	.392	.167	.359	.129
Age 30–39	30.7	.295	.107	.810	.096
Age 40–49	35.8	.283	.096	.802	.094
Age 50–64	20.3	.278	.128	.415	.110
Educational attainment					
Elementary school or below	2.1	.593	.505	.226	.139
Junior high school	20.7	.433	.135	.447	.101
High school	25.2	.355	.107	.566	.098
Vocational school	12.0	.314	.112	.673	.131
Junior college	24.8	.246	.086	.801	.092
College or above	15.2	.183	.085	.797	.120
Industry					
Mining	2.3	.291	.201	–	–
Manufacturing	21.6	.346	.134	–	–
Power production and supply	3.4	.248	.142	–	–
Construction	3.2	.352	.211	–	–
Transportation and postal service	7.6	.288	.132	–	–
Information technology	2.4	.292	.314	–	–
Wholesales and retail sales	9.9	.471	.197	–	–
Hotel and restaurant	2.7	.498	.333	–	–
Banking and finance	2.9	.234	.157	–	–
Real estate	1.9	.355	.353	–	–
Leasing and commercial service	1.6	.371	.313	–	–
Scientific research	2.1	.204	.175	–	–
Environment and public facility	1.3	.311	.212	–	–
Housekeeping	9.6	.509	.213	–	–
Education	7.2	.237	.101	–	–
Health care	4.8	.265	.170	–	–
Sports and entertainment	1.8	.280	.226	–	–
Public service	13.9	.245	.094	–	–
Total observations	620,321				

The average wage is calculated as the mean wage in each category. Because age cohort 16–19 and 20–24 only account for .17 percent and 3.6 percent of total observations, respectively, we choose the first age cohort to be age 16–29

also shows the two key variables by age cohort and educational attainment over the 2004–2009 period. Indeed, we find that young Chinese workers aged 15 to 29 have the highest minimum-to-average-wage ratio (.392), at least 10 percentage points higher than those of other age cohorts. For workers with different levels of skills, the evidence demonstrates that as the skill level increases, the minimum-to-average-wage ratio decreases quickly—dropping continuously from .389 for high school education or below to .183 for college or above education.

Table 2 also presents the minimum-to-average-wage ratio by industry. The manufacturing sector contains the largest share (21.6%) of workers in our sample; the public service sector is the second-largest (13.9%); and the third and the fourth sectors are wholesale and retail sales trade (9.9%) and housekeeping (9.6%), respectively. As to the minimum-to-average-wage ratios, unsurprisingly, we find that the housekeeping sector has the highest ratio (.509) among all industries, followed by the hotel and restaurant sector (.498) and wholesale and retail sales trade (.471).

We also provide a summary of the characteristics of workers who earn the minimum wage as well as less/more than the minimum wage over 2004–2009 in Table 3. The first row of Table 3 shows that approximately 5.62% of all workers earned less than the minimum wage and 3.28% earned just the minimum.[21] Among those who earned the exact minimum wage or less than the minimum wage, 63.84 and 61.52% are females, respectively. Furthermore, the minimum-to-average-wage ratio of workers receiving less than the minimum wage is 2.52, suggesting that these disadvantaged workers earn a wage that is only approximately one-quarter of the official standard.

3.2 Research design

Our empirical strategy is to estimate the impact of minimum wages on the employment of potentially affected workers. As noted in Section 1, nearly all existing studies on minimum wages in China use aggregated data (from the year books) at the provincial level and tend to find mixed results, implying that convincing evidence of the employment effects has not yet been established. Our study takes advantage of household survey data and a more accurate measure of minimum wages at the county level. This in turn allows us to calculate the dependent variable—the employment-to-population ratio—at the county level, which contains more variation and information on local conditions. These unique features of our data provide us an opportunity to generate more reliable estimates of the employment effects of minimum wages in China.

First, we estimate the effect of minimum wages on average wages to see whether changes in the minimum wage indeed affect the observed wages of the groups being examined in our analysis. We then estimate a standard set of equations as used in Neumark (2001); Campolieti et al. (2006); Wang and Gunderson (2011).[22]

Our estimation equations for the wage and employment effects are as follows:

$$W_{i,t} = \eta_0 + \eta_1 MWL_{i,t} + \eta_2 MWL_{i,t-1} + X_{i,t}\theta + Y_t\mu + C_i\tau + \varepsilon_{i,t}, \quad (1)$$

$$E_{i,t} = \alpha_0 + \alpha_1 MW_{i,t} + \alpha_2 MW_{i,t-1} + X_{i,t}\beta + Y_t\gamma + C_i\delta + e_{i,t}, \quad (2)$$

where $W_{i,t}$ is the log of the average wage variable for county i in year t; $MWL_{i,t}$ and $MWL_{i,t-1}$ are the log of minimum wage variables (in level) for county i in year t and year t-1, respectively. $E_{i,t}$ is the log of employment variable (employment-to-population

Table 3 Characteristics of workers earning the minimum wage, 2004–2009

Variable	Less than minimum	Minimum	Above minimum
Percent of total (%)	5.62	3.28	91.09
Percent of female (%)	61.52	63.84	42.99
Minimum/Average wage	2.52	1.00	.35
	(4.66)	(.06)	(.20)
Region (%)			
East	5.33	3.27	91.40
Central	5.46	2.88	91.66
West	7.26	4.36	88.38
Age			
Age 15–29	9.53	4.30	86.17
Age 30–39	4.73	2.84	92.43
Age 40–49	4.90	3.26	91.83
Age 50–64	5.73	3.33	90.94
Educational attainment			
Elementary school or below	15.75	9.41	74.84
Junior high school	9.43	6.00	84.57
High school	6.60	3.99	89.40
Vocational school	4.89	2.85	92.26
Junior college	3.08	1.50	95.43
College or above	2.17	.82	97.01
Industry			
Mining	3.10	1.88	95.02
Manufacturing	5.50	3.30	91.20
Power production and supply	2.47	1.37	96.16
Construction	5.78	3.04	91.17
Transportation and postal service	4.00	2.10	93.90
Information technology	5.42	2.27	92.31
Wholesales and retail sales	10.46	6.30	83.24
Hotel and restaurant	9.98	6.52	83.50
Banking and finance	2.74	1.21	96.04
Real estate	5.46	3.05	91.49
Leasing and commercial service	6.37	3.16	90.46
Scientific research	2.20	.84	96.96
Environment and public facility	3.89	2.23	93.87
Housekeeping	12.63	7.58	79.79
Education	2.74	1.39	95.87
Health care	3.57	1.74	94.69
Sports and entertainment	4.10	1.77	94.13
Public service	2.41	1.77	95.82

Standard deviations are in parentheses. There are 620,321 observations in this period. "Less than the Minimum" are workers earning wages at or below 90 percent of the minimum wage. Minimum wage workers earn wages above 90 percent and up to 110 percent of the minimum wage. Above minimum wage workers earn wages above 110 percent of the minimum wage

ratio) of the relevant group e.g., young adult workers employed in urban (county) units divided by the urban working age population (15–64) for county i in year t; $MW_{i,t}$ and $MW_{i,t-1}$ are the log of minimum wage index variables (minimum-to-average-wage ratio) for county i in year t and year t-1, respectively. We include $MW_{i,t-1}$ in the equation to allow a lagged effect of minimum wages to occur as suggested by Burkhauser et al. (2000); X is a set of control variables to capture aggregate business cycle effects; Y_t is a set of fixed year effects; and C_i is a set of fixed county effects. The disturbance terms ε and e are assumed to be serially uncorrelated and orthogonal to the independent variables.

To address the potential bias from misspecification and factors that may affect labor demand, we include several control variables in the estimation equations. First, the county GDP per capita and CPI (at city level) capture aggregate business cycle effects and controls for the Great Recession. Second, county-level foreign direct investment (FDI) is used to control for the possibility that provinces may restrain minimum wage increases to attract foreign investment (Frost 2002) and other factors that may affect the relative labor demand for workers with different skills. We controlled for such local condition variables as they are potential determinants of minimum wage decisions.

4 Empirical results and discussion

4.1 Minimum wage effects across regions

We first present estimates of minimum wage effects on the wages of young adults, at-risk groups, and the entire sample for the East, Central, West regions, and all regions in Table 4. In each region, we estimate Eq. (1) using a fixed-effects model with both fixed year and county effects. All regressions are appropriately weighted by the size of the population in each county and adjust the weight to be the size for the groups such as age, gender, etc.

Our results show that, for each of the three groups, the current year minimum wage has a statistically significant and positive effect on the average wage for the East, Central, and all regions over 2004–2009. We also find positive but milder effects of the one-year lagged minimum wage variable on the average wage nationwide. However, we do not find any significant wage effect in the Western region. In short, we show that minimum wage changes in the East, Central, and all regions have positively affected the observed wages of young adults, at-risk groups, and the entire sample of workers.[23]

Next, using Eq. (2), we estimate the effect of the minimum wage on employment for young adults, at-risk groups, and the entire sample for the East, Central, West regions, and all regions respectively, and present the results in Table 5. We report the results of two estimation equations for each of the three groups: the first equation uses the minimum wage of the current year t ($MW_{i,t}$) and the previous year t-1 ($MW_{i,t-1}$) only, while the second equation further controls for CPI (city level), county GDP per capita, and county FDI (shown as Other controls in the table).

The first and second columns of Table 5 report the estimates with cluster-robust standard errors at the county level in parentheses for young adults and at-risk groups across different regions using Eq. (2), while in the third column, we report estimates of the entire sample for comparison. The significance of our results is compelling: for the entire country, we find negative effects of the current and lagged minimum wage on

Table 4 Estimates of minimum wage effects on wages

Dependent variable: log (Wages)	Young adults (Age 15–29)		At-risk group		Entire sample	
Independent variables (log)	(1)	(2)	(1)	(2)	(1)	(2)
	A. All Regions					
MW level, current year	.782***	.429***	.873***	.883***	.545***	.300***
	(.077)	(.084)	(.034)	(.039)	(.044)	(.050)
MW level, lagged 1 year	.360***	.083*	.100***	.108***	.339***	.171***
	(.076)	(.042)	(.033)	(.036)	(.042)	(.046)
Other controls	No	Yes	No	Yes	No	Yes
R^2	.511	.558	.916	.936	.626	.659
Number of observations	3,894	3,894	3,372	3,372	3,966	3,966
	B. East					
MW level, current year	1.434***	.890***	.861***	.905***	.666***	.229***
	(.114)	(.141)	(.097)	(.055)	(.071)	(.075)
MW level, lagged 1 year	.184	.037	.115**	.095*	.449***	.186***
	(.117)	(.124)	(.055)	(.050)	(.060)	(.071)
Other controls	No	Yes	No	Yes	No	Yes
R^2	.676	.700	.933	.934	.698	.718
Number of counties	1,716	1,716	1,518	1,518	1,734	1,734
	C. Central					
MW level, current year	.257**	.080*	.874***	.884***	.289***	.256***
	(.118)	(.045)	(.055)	(.061)	(.063)	(.068)
MW level, lagged 1 year	.241**	.205*	.108**	.116*	.078	.009
	(.122)	(.112)	(.055)	(.062)	(.067)	(.069)
Other controls	No	Yes	No	Yes	No	Yes
R^2	.306	.359	.854	.883	.515	.552
Number of counties	1,638	1,638	1,380	1,380	1,674	1,674
	D. West					
MW level, current year	.601	.328	1.014	.837	.523	.450
	(.387)	(.517)	(.873)	(.867)	(.377)	(.399)
MW level, lagged 1 year	.233	.477	.022	.102	.087	.040
	(.350)	(.480)	(.091)	(.188)	(.233)	(.348)
Other controls	No	Yes	No	Yes	No	Yes
R^2	.330	.352	.870	.889	.348	.356
Number of counties	540	540	474	474	558	558

Cluster-robust standard errors at the county level are in parentheses. All variables in the table are at the county level, except that CPI is at the city level. Young adults are defined as workers who are 15–29 years old. At-risk groups are workers whose monthly wages are between the old and new minimum wage standards. Each estimation has controlled for year and county fixed effects

***Statistically significant at the 1 percent level; **at the 5 percent level; *at the 10 percent level

employment. For young adults, the estimated elasticities for the current and lagged effects are in the range of −.062 to −.088 and −.136 to −.156, respectively. For the entire sample of individuals, the estimated elasticities for the current and lagged effects are in the range of −.045 to −.055 and −.028 to −.031, respectively.[24]

In the more developed and prosperous East China, covering large urban centers such as Beijing, Shanghai, and Guangzhou, the minimum wage has been an important policy tool as China makes the critical transition into a market economy. Consequently, the

Table 5 Estimates of minimum wage effects on the employment-to-population ratio

Dependent variable: log (Employment/Population)	Young adults (Age 15–29)		At-risk group		Entire sample	
Independent variables (log)	(1)	(2)	(1)	(2)	(1)	(2)
	A. All Regions					
MW, current year	−.088**	−.062	−.213*	−.200	−.055***	−.045**
	(.042)	(.043)	(.128)	(.129)	(.018)	(.018)
MW, lagged 1 year	−.156***	−.136***	−.340***	−.265***	−.031***	−.028**
	(.040)	(.042)	(.102)	(.102)	(.012)	(.011)
MW, sum current and lagged	−.244***	−.198***	−.552***	−.465**	−.086***	−.073***
	(.055)	(.058)	(.192)	(.195)	(.019)	(.019)
Other controls	No	Yes	No	Yes	No	Yes
R^2	.144	.218	.024	.025	.079	.091
Number of counties per year	649	649	562	562	661	661
Average obs. per county per year	270	270	170	170	1658	1658
	B. East					
MW, current year	−.234***	−.154**	−.201	−.213	−.068***	−.067**
	(.047)	(.070)	(.219)	(.220)	(.025)	(.027)
MW, lagged 1 year	−.100**	−.046	−.322**	−.310**	−.018	−.015
	(.048)	(.057)	(.128)	(.124)	(.020)	(.020)
MW, sum current and lagged	−.334***	−.201**	−.523*	−.523*	−.086***	−.082***
	(.043)	(.097)	(.307)	(.304)	(.020)	(.025)
Other controls	No	Yes	No	Yes	No	Yes
R^2	.213	.223	.041	.056	.084	.085
Number of counties per year	286	286	253	253	289	289
Average obs. per county per year	329	329	180	180	1917	1917
	C. Central					
MW, current year	−.032	−.034	−.297	−.272	−.039	−.039
	(.068)	(.070)	(.181)	(.177)	(.025)	(.026)
MW, lagged 1 year	−.216***	−.216***	−.336*	−.310*	−.041***	−.042***
	(.061)	(.061)	(.174)	(.184)	(.015)	(.014)
MW, sum current and lagged	−.248***	−.250***	−.632**	−.582*	−.080***	−.081***
	(.090)	(.093)	(.297)	(.302)	(.030)	(.031)
Other controls	No	Yes	No	Yes	No	Yes
R^2	.129	.151	.031	.043	.094	.133
Number of counties per year	273	273	230	230	279	279
Average obs. per county per year	214	214	154	154	1385	1385
	D. West					
MW, current year	.088	−.037	.018	.022	−.096	−.069
	(.114)	(.106)	(.208)	(.223)	(.063)	(.064)
MW, lagged 1 year	.124	−.153	.000	.124	.055	−.005
	(.107)	(.110)	(.258)	(.276)	(.075)	(.043)
MW, sum current and lagged	.212	−.191	.018	.146	−.041	−.074
	(.191)	(.161)	(.321)	(.384)	(.080)	(.096)

Table 5 Estimates of minimum wage effects on the employment-to-population ratio *(Continued)*

Other controls	No	Yes	No	Yes	No	Yes
R^2	.153	.169	.014	.051	.015	.043
Number of counties per year	90	90	79	79	93	93
Average obs. per county per year	250	250	181	181	1673	1673

Cluster-robust standard errors at the county level are in parentheses. All variables in the table are at the county level, except that CPI is at the city level. At-risk groups are workers whose monthly wages are between the old and new minimum wage standards. Among young adults, less than 3 percent are at-risk groups in each region; likewise, among at-risk group, less than 3 percent are young adults in each region. Each estimation has controlled for year and county fixed effects

***Statistically significant at the 1 percent level; **at the 5 percent level; *at the 10 percent level

magnitude and frequency of minimum wage increases are relatively high and the impact of minimum wages on employment can be evident. Indeed, this is consistent with our results in Table 5. Our estimates indicate that minimum wage increases in the Eastern region have a statistically significant adverse impact on employment with elasticities ranging from −.154 to −.234 and a lagged adverse effect with an elasticity of −.046 to −.100 for young adults. Furthermore, we find a large and negative one-year lagged minimum wage effect on the employment for the at-risk groups—the estimated elasticity for the lagged effect is in the range of −.310 to −.322. The current minimum wage effects are negative but statistically insignificant.

In the developing Central region, we also find that one-year lagged minimum wages have a strong negative employment effect on young adults, at-risk groups, and the entire working population. For the entire working population in the Central region, the elasticity is in the range of −.041 to −.042. The estimated effect of the current minimum wage is negative but statistically insignificant. Finally, in the less developed West, although the estimated coefficients are relatively larger, we do not find a statistically significant effect of the minimum wage on employment. Therefore, we don't report the estimates for the West here and leave the discussion of the result in Section 4.4.

4.2 Gender and age cohort

A large number of international studies of minimum wages have reported that young workers are most vulnerable to minimum wage increases, and the disemployment effect seems especially strong for teenagers. Female workers are particularly disadvantaged in the labor market. We therefore separate the sample into four age subgroups: 15–29, 30–39, 40–49, and 50–64.[25] In each age group, we estimate Eq. (2) of the fixed-effects model separately for males and females and report the results in Table 6.

Consistent with most studies in the literature, we find that the minimum wage has strong negative effects on young female workers (age 15–29)—the most disadvantaged and vulnerable groups in the labor market. In contrast, we do not find significant effects on the employment of young male workers (age 15–29) and older workers (age 50–64) in the full sample.

4.3 Skill level

In the extant literature, the bulk of evidence supports the view that minimum wages reduce the employment of low-wage workers. Moreover, when researchers focus on the least-skilled groups, which are most likely to be directly affected by minimum wage

Table 6 Estimates of minimum wage effects on employment by age cohort

Dependent variable: log (Employment/Population)	Age 15–29		Age 30–39		Age 40–49		Age 50–64	
Independent variables (log)	Male	Female	Male	Female	Male	Female	Male	Female
	A. All Regions							
MW, current year	−.031	−.148***	−.019	−.068***	.017	−.040	.009	.023
	(.047)	(.047)	(.027)	(.025)	(.016)	(.027)	(.053)	(.056)
MW, lagged 1 year	−.027	−.061**	−.031	−.034	−.015	−.040**	−.009	−.023
	(.029)	(.030)	(.019)	(.021)	(.013)	(.017)	(.032)	(.034)
MW, sum current and lagged	−.058	−.210***	−.050	−.102***	−.003	−.080**	−.000	−.000
	(.053)	(.050)	(.039)	(.027)	(.024)	(.025)	(.072)	(.073)
Minimum–to–average wage ratio	.388	.442	.266	.353	.252	.362	.260	.403
MW (level) effects on wages	.433***	.442***	.442***	.356***	.345***	.239***	.498***	.368**
	(.126)	(.117)	(.071)	(.078)	(.071)	(.086)	(.082)	(.156)
R^2	.173	.169	.022	.097	.012	.093	.052	.055
Number of counties per year	632	626	654	653	655	653	653	598
Average obs. per county per year	113	114	253	260	309	272	231	100
	B. East							
MW, current year	−.103	−.172**	−.023	−.098***	−.001	−.043	.022	−.057
	(.112)	(.076)	(.022)	(.033)	(.017)	(.032)	(.042)	(.061)
MW, lagged 1 year	−.012	−.040	−.010	.007	−.016	−.021	−.018	−.001
	(.049)	(.046)	(.011)	(.024)	(.013)	(.025)	(.031)	(.041)
MW, sum current and lagged	−.116	−.212***	−.033	−.091***	−.016	−.064**	.004	−.059
	(.136)	(.071)	(.021)	(.033)	(.018)	(.029)	(.042)	(.067)
Minimum–to–average wage ratio	.353	.415	.247	.344	.240	.367	.245	.424
MW (level) effects on wages	.999***	.895***	.664***	.393***	.196	.256	.252	.442
	(.186)	(.194)	(.118)	(.127)	(.125)	(.158)	(.147)	(.324)
R^2	.176	.195	.049	.094	.013	.092	.039	.094
Number of counties per year	280	280	285	287	288	285	286	269
Average obs. per county per year	131	144	299	308	337	302	266	108
	C. Central							
MW, current year	.014	−.155**	−.052**	−.087**	.013	.034	.025	.152**
	(.062)	(.068)	(.020)	(.040)	(.023)	(.062)	(.085)	(.075)
MW, lagged 1 year	−.014	−.066	−.072***	−.071**	−.018	−.013	.021	−.024
	(.068)	(.044)	(.020)	(.036)	(.022)	(.029)	(.052)	(.047)
MW, sum current and lagged	−.001	−.220***	−.123***	−.158***	−.006	.021	.047	.128
	(.082)	(.077)	(.024)	(.051)	(.039)	(.077)	(.124)	(.092)
Minimum–to–average wage ratio	.433	.482	.278	.360	.256	.354	.264	.368
MW (level) effects on wages	.425*	.114*	.295***	.311***	.290***	.260**	.346	.500***
	(.222)	(.068)	(.092)	(.109)	(.096)	(.123)	(.239)	(.125)
R^2	.123	.114	.076	.148	.015	.057	.044	.089
Number of counties per year	265	260	276	273	275	277	276	246
Average obs. per county per year	87	94	211	212	276	235	186	95
	D. West							
MW, current year	−.071	−.145	.231*	.078	.093	−.018	−.394**	−.400***
	(.170)	(.109)	(.123)	(.078)	(.080)	(.111)	(.188)	(.120)

Table 6 Estimates of minimum wage effects on employment by age cohort *(Continued)*

MW, lagged 1 year	−.121	−.215*	.117**	−.103**	.004	.066	−.136	−.037
	(.124)	(.110)	(.053)	(.046)	(.053)	(.072)	(.139)	(.093)
MW, sum current and lagged	−.192	−.360*	.348**	−.026	.097	.048	−.530*	−.437**
	(.180)	(.187)	(.166)	(.091)	(.116)	(.156)	(.283)	(.178)
Minimum–to–average wage ratio	.451	.470	.310	.370	.290	.362	.313	.389
MW (level) effects on wages	.610	.511**	.624	.553**	.399	.442	.388***	.217***
	(.893)	(.246)	(.482)	(.269)	(.520)	(.549)	(.133)	(.048)
R^2	.172	.179	.236	.152	.102	.085	.091	.269
Number of counties per year	87	86	93	93	92	91	91	93
Average obs. per county per year	101	107	237	255	316	288	253	107

Cluster–robust standard errors at the county level are in parentheses. All variables in the table are at the county level, except that CPI is at the city level. Each estimation has controlled for year and county fixed effects as well as other control variables as described in Section 3.2. In each panel, the estimates of MW effects on wages are taken from Additional file 1: Table S1

***Statistically significant at the 1 percent level; **at the 5 percent level; *at the 10 percent level

increases, the evidence for disemployment effects seems to be especially strong (Neumark and Wascher 2008). We present the estimation results by three skill groups as measured by educational attainment in Table 7. In each group, we report the estimates using the fixed-effects model with both fixed year and county effects. Our results show that minimum wages reduce the employment of low-skilled workers, indicating that Chinese workers who have high school education or less, and those who have vocational school degrees were adversely affected by minimum wage increases.[26] In contrast, we do not find an effect of minimum wages on workers with a college degree or above (including junior college).

4.4 Discussion of the results

We began with estimating the employment effects of minimum wages by three geographical regions and sought to explain the impact for the 2004–2009 period. The estimates showed that in the more developed East China, the negative employment effects of the current and lagged minimum wages on young adults are statistically significant, with elasticities in the range of −.088 and −.136 to −.156, respectively. Although the numbers are small, they are in the range of those found in the studies of developed and developing countries, and are very likely inside of the consensus range of −.1 to −.3 from the earlier literature as noted in Neumark and Wascher (2008).

Moreover, we find that minimum wage changes result in a larger lagged disemployment effect for at-risk groups across the country, with elasticities ranging from −.265 to −.340. In particular, these effects are consistently more pronounced for both young adults and at-risk groups in the Central region. The fact that nearly all the lagged effects are uniformly more pronounced than the current contemporaneous effects for young adults and at-risk groups highlights the importance of the adjustment period through which the disemployment effects would occur. It is worth noting that our finding of a lagged disemployment effect is not an anomaly among the empirical studies in the extant minimum wage literature. Hamermesh (1995) points out that nonlabor inputs such as capital may be costly and slow to adjust in the short run, which will also tend to slow the adjustment of other complementary inputs such as labor. Subsequent

Table 7 Estimates of minimum wage effects on employment by educational attainment

Dependent variable: log (Employment/Population)	High school or below		Vocational school		Junior college		College or above	
Independent variables (log)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
	A. All Regions							
MW, current year	−.080**	−.054**	−.037	−.046*	−.018	−.023	−.006	−.013
	(.040)	(.025)	(.025)	(.025)	(.020)	(.020)	(.013)	(.014)
MW, lagged 1 year	−.019	−.029	−.040**	−.047**	−.002	−.016	−.005	−.019
	(.020)	(.018)	(.020)	(.020)	(.021)	(.021)	(.015)	(.015)
MW, sum current and lagged	−.099***	−.083***	−.077***	−.092***	−.020	−.039	−.011	−.032
	(.030)	(.029)	(.027)	(.027)	(.018)	(.024)	(.015)	(.021)
MW (level) effects on wages	.541***	.326***	.560***	.391***	.056	.053	.157*	.187
	(.056)	(.066)	(.072)	(.078)	(.084)	(.088)	(.095)	(.119)
Other controls	No	Yes	No	Yes	No	Yes	No	Yes
R^2	.046	.076	.036	.068	.044	.079	.003	.032
Number of counties per year	659	659	636	636	653	653	632	632
Average obs. per county per year	744	744	196	196	408	408	277	277
	B. East							
MW, current year	−.070*	−.061	−.049	−.054	−.048	−.064	−.031	−.032
	(.038)	(.041)	(.046)	(.047)	(.037)	(.040)	(.020)	(.020)
MW, lagged 1 year	−.025	−.017	−.003	−.006	.028	.018	−.039	−.039
	(.023)	(.024)	(.028)	(.030)	(.027)	(.028)	(.027)	(.027)
MW, sum current and lagged	−.095***	−.079*	−.052	−.060	.020	−.046	−.069	−.072
	(.036)	(.043)	(.054)	(.054)	(.021)	(.035)	(.045)	(.058)
MW (level) effects on wages	.720***	.300***	.619***	.419***	.044	.005	.335	.346
	(.087)	(.110)	(.110)	(.143)	(.186)	(.182)	(.258)	(.254)
Other controls	No	Yes	No	Yes	No	Yes	No	Yes
R^2	.056	.062	.028	.036	.053	.091	.011	.032
Number of counties per year	289	289	281	281	286	286	284	284
Average obs. per county per year	819	819	224	224	476	476	355	355
	C. Central							
MW, current year	−.071**	−.077**	−.048	−.051	.012	.007	.074	.077
	(.034)	(.035)	(.037)	(.037)	(.023)	(.023)	(.056)	(.057)
MW, lagged 1 year	−.052**	−.047*	−.083***	−.090***	−.030	−.033	.080	.079
	(.025)	(.025)	(.032)	(.033)	(.033)	(.034)	(.038)	(.038)
MW, sum current and lagged	−.123***	−.124***	−.131***	−.141***	−.018	−.026	.155	.157
	(.043)	(.043)	(.040)	(.040)	(.034)	(.035)	(.107)	(.109)
MW (level) effects on wages	.391***	.326***	.434***	.409***	.024	.070	.016	.051
	(.084)	(.091)	(.107)	(.107)	(.105)	(.118)	(.130)	(.143)
Other controls	No	Yes	No	Yes	No	Yes	No	Yes
R^2	.083	.111	.073	.094	.045	.082	.045	.046
Number of counties per year	277	277	263	263	274	274	259	259
Average obs. per county per year	650	650	170	170	341	341	197	197
	D. West							
MW, current year	−.184	−.030	−.019	.012	−.068	−.034	.033	.112
	(.163)	(.092)	(.073)	(.086)	(.062)	(.060)	(.084)	(.103)

Table 7 Estimates of minimum wage effects on employment by educational attainment *(Continued)*

MW, lagged 1 year	.154	−.037	−.046	−.031	.020	−.021	−.020	−.054
	(.120)	(.092)	(.090)	(.089)	(.078)	(.072)	(.070)	(.062)
MW, sum current and lagged	−.031	−.068	−.065	−.019	−.048	−.055	.013	.058
	(.120)	(.092)	(.104)	(.111)	(.081)	(.097)	(.106)	(.138)
MW (level) effects on wages	.365	.060	.436	.605	.424	.232	.498	.343
	(.348)	(.461)	(.398)	(.607)	(.294)	(.411)	(.386)	(.451)
Other controls	No	Yes	No	Yes	No	Yes	No	Yes
R^2	.013	.059	.028	.052	.017	.099	.019	.080
Number of counties per year	93	93	92	92	93	93	89	89
Average obs. per county per year	791	791	183	183	394	394	258	258

Cluster–robust standard errors at the county level are in parentheses. All variables in the table are at county level. All variables in the table are at the county level, except that CPI is at the city level. Each estimation has controlled for year and county fixed effects. In each panel, the estimates of MW effects on wages are taken from Additional file 1: Table S2
***Statistically significant at the 1 percent level; **at the 5 percent level; *at the 10 percent level

empirical studies have tended to find evidence of longer-run disemployment effects of minimum wages: for example, Baker et al. (1999) based on Canadian data, Keil et al. (2001) based on a panel of U.S. state-based data, Burkhauser et al. (2000) based on Current Population Survey data, and Wang and Gunderson (2011) based on a Chinese provincial-level panel data.

Our full sample results (age 15–64) reported in column 3 of Table 5 show negative employment effects across the country and in the Eastern region, which is consistent with the findings by Ni et al. (2011), who used general working population (age 15 and above) in their analysis. When focusing on young adults and at-risk groups (which are more likely to be affected by the minimum wage policy), we found stronger disemployment effects in the East, lagged disemployment effects in the Central, and positive while insignificant effects in the Western region. The differential disemployment effects across regions can be explained in part by the fact that in the Central and Western regions young adults and at-risk groups tend to work in the state-owned enterprises—a sector that is considerably inefficient and less responsive to market pressures (Lin et al. 2001).[27]

Taken together, our results show heterogeneous employment effects of minimum wages by region, skill, and gender.[28] In particular, the effect on young adults and at-risk groups varies, highlighting the importance of heterogeneous effects of minimum wages by the characteristics of those affected.[29]

4.5 Robustness checks

4.5.1 Normalized minimum wage

In their influential works, Neumark and Wascher (1992); Card et al. (1994) discuss the potential endogeneity issue when normalizing the minimum wage by the average wage which we use in our analysis. The main concern of using a normalized minimum wage variable is that average wages can be related to supply and demand factors (which also affect youth employment) and are affected by minimum wage changes. That is, if wages increase more slowly in places where employment grows more slowly, one could possibly find a negative relationship between normalized minimum wages and employment even when the minimum wage does not increase.

To address this concern, we estimate a non-normalized minimum wage model and control for average wages of groups that are not being examined in the regression as an additional covariate (e.g., in the young adults regressions, we use the average wage of non-young adults as an additional control) and show those results in Table 8. Overall, we find that our results are robust whether or not the minimum wages are normalized. That is, we still find statistically significant disemployment effects in the East, Central and all regions for young adults, at-risk groups, and for the entire sample. And we do not find any effect in the Western region.

4.5.2 Representativeness of the sample

The fact that the NBS only allows limited access to the microdata up to 16 provinces could cast doubt on the representativeness of the 16-province UHS sample to the entire population. To address this concern, we utilize the 2005 Census data to compare descriptive statistics of the 16 sample provinces with the 15 provinces not in our sample, along with the entire census sample.

We check the representativeness of our 16 sample provinces by comparing the descriptive statistics of the UHS with those of the 2005 Census and report the comparisons in Table 9. We also compute the two key variables—minimum wage-to-average wage ratio and employment-to-population ratio—by gender, region, age cohort, and educational attainment for all provinces, 16 provinces in our sample, and 15 provinces not in our sample. The numbers for all provinces and 16 provinces are relatively close to those of 15 provinces not in the sample. In other words, Table 9 provides evidence that our 16-province UHS sample is representative of the whole country.

5 Conclusions

We use a large county-level panel dataset that contains relevant information on minimum wages, combined with urban household survey microdata from 16 representative provinces, to estimate the employment effect of minimum wage changes in China over the 2004–2009 period. Compared to previous studies using provincial-level data and reporting mixed results, we find that minimum wage changes in China led to significant negative effects on the employment in the Eastern and Central regions, and caused disemployment for young adults and low-skilled workers, particularly at-risk groups.

Our study makes a number of significant contributions to the empirical literature on minimum wages in China, the largest transitional economy in the world. First, the use of detailed county-level data (over 1,400 counties) provides greater accuracy and more variations (127 changes) of minimum wages in order to measure their real impact on employment. Second, the unique features of the UHS microdata allow us to directly evaluate the employment effects of minimum wages on those population groups that are at risk of being affected by minimum wage increases, such as young adults and low-skilled workers. Third, our results are robust to various definitions of minimum wages and the workforce, various subsamples by region, and across a number of population groups. Fourth, minimum wages were strongly enforced after the new Minimum Wage Regulations were enacted in 2004, as such they are expected to have more significant employment effects after 2004. Our results show that minimum wages in the provinces with vigorous enforcement did increase wages of the workers while

Table 8 Estimates of minimum wage effects on the employment (Non–normalized minimum wage variable)

Dependent variable: log (Employment/Population)	Young adults (Age 15–29)		At–risk group		Entire sample	
Independent variables (log)	(1)	(2)	(1)	(2)	(1)	(2)
	A. All Regions					
MW level, current year	−.120*	−.005	−.093	−.263*	−.009	−.018**
	(.072)	(.082)	(.084)	(.158)	(.017)	(.010)
MW level, lagged 1 year	−.228***	−.060***	−.047**	−.268***	.016*	−.024**
	(.077)	(.028)	(.024)	(.102)	(.009)	(.013)
MW, sum current and lagged	−.348***	−.065***	−.140*	−.531***	.007	−.039***
	(.075)	(.032)	(.071)	(.121)	(.010)	(.011)
Mean wages[a]	No	Yes	No	Yes	No	Yes
Other controls	No	Yes	No	Yes	No	Yes
R^2	.070	.202	.008	.025	.026	.101
Number of counties per year	649	649	562	562	661	661
Average obs. per county per year	270	270	170	170	1658	1658
	B. East					
MW level, current year	−.198***	−.170**	−.050	−.073	−.047*	−.026***
	(.101)	(.090)	(.161)	(.274)	(.028)	(.013)
MW level, lagged 1 year	−.150**	−.171	−.114*	−.206***	−.026	−.025
	(.081)	(.124)	(.068)	(.102)	(.031)	(.031)
MW, sum current and lagged	−.348*	−.341*	−.164**	−.279***	−.073**	−.051***
	(.187)	(.179)	(.079)	(.112)	(.036)	(.021)
Mean wages[a]	No	Yes	No	Yes	No	Yes
Other controls	No	Yes	No	Yes	No	Yes
R^2	.080	.221	.017	.046	.084	.093
Number of counties per year	286	286	253	253	289	289
Average obs. per county per year	329	329	180	180	1917	1917
	C. Central					
MW level, current year	−.054	−.056	−.043	−.023	−.038	−.033
	(.125)	(.142)	(.124)	(.173)	(.030)	(.035)
MW level, lagged 1 year	−.126*	−.234*	−.067	−.248***	−.032*	−.046***
	(.075)	(.126)	(.114)	(.119)	(.017)	(.018)
MW, sum current and lagged	−.180*	−.290**	−.110	−.271**	−.070***	−.079***
	(.091)	(.140)	(.109)	(.124)	(.027)	(.025)
Mean wages[a]	No	Yes	No	Yes	No	Yes
Other controls	No	Yes	No	Yes	No	Yes
R^2	.067	.126	.018	.050	.031	.122
Number of counties per year	273	273	230	230	279	279
Average obs. per county per year	214	214	154	154	1385	1385
	D. West					
MW level, current year	.021	−.117	.114	.144	−.042	−.166
	(.118)	(.186)	(.599)	(.536)	(.365)	(.244)
MW level, lagged 1 year	.176	.510	−.026	−.178	−.021	−.347
	(.520)	(.662)	(.434)	(.534)	(.183)	(.238)

Table 8 Estimates of minimum wage effects on the employment (Non–normalized minimum wage variable) *(Continued)*

MW, sum current and lagged	.197	.393	.088	−.034	−.063	−.513
	(.476)	(.581)	(.536)	(.534)	(.270)	(.340)
Mean wages[a]	No	Yes	No	Yes	No	Yes
Other controls	No	Yes	No	Yes	No	Yes
R^2	.058	.168	.030	.076	.059	.160
Number of counties per year	90	90	79	79	93	93
Average obs. per county per year	250	250	181	181	1673	1673

***Statistically significant at the 1 percent level; **at the 5 percent level; *at the 10 percent level
[a]The control variables for the mean wage of young adults and at risk groups are mean wages of non–young adults and non–at risk groups, respectively. The control variable for mean wage of the entire sample is the mean wage of the entire sample. Each estimation has controlled for year and county fixed effects
Cluster–robust standard errors at the county level are in parentheses

adversely affecting their employment, especially for young adults and low-skilled workers.

Endnotes

[1]Nevertheless, these two positions are not necessarily in conflict. The minimum wage can have negative impacts but also serve those other goals advocated by its supporters. The existing evidence has shown that the minimum wage poses a tradeoff of higher income for some against job losses for others.

[2]There is no national minimum wage in China; rather, the minimum wage standards are determined at the provincial level. We discuss how we calculate the mean nominal minimum wages of each year in Section 3.1.

[3]The growth rates of average nominal wage are 155 and 194% for the periods of 1995–2003 and 2004–2012, respectively.

[4]The theoretically expected effect of minimum wages on employment is well established in the literature. For examples, see reviews in Card and Krueger (1995); Brown (1999); Gunderson (2005); Cunningham (2007); Neumark and Wascher (2008). However, there is no consensus in the existing empirical studies on the magnitude of disemployment effect associated with minimum wage changes. Please refer to Neumark and Wascher (2007) for the most extensive survey of employment effects; Card (1992); Card and Krueger (1994, 1995, 2000); Neumark and Wascher (1992, 1995); Williams (1993) for U.S. evidence; Machin and Manning (1994); Dickens et al. (1999); Stewart (2004); Metcalf (2008) for British evidence; Campolieti et al. (2005); Campolieti et al. (2006) for Canadian evidence.

[5]For expositional convenience, we refer to "provinces, municipalities, and autonomous regions" as provinces.

[6]The implementation date of a new minimum wage standard for a county can also differ across geographically contiguous neighbors within the same province. For example, Liaoning Province has the most complicated minimum wage scheme, in which 14 jurisdictions may enact their own standards on different dates. For instance, in 2007, Shenyang, Benxi, Dandong, and Panjin cities did not increase their minimum wages. In contrast, Dalian and Anshan cities increased their minimum wages from 600 to 700 RMB on December 20th, on which day Jinzhou and Liaoyang cities increased their minimum wages from 480 to 580 RMB and Chaoyang city increased its minimum wage from 350 to 530 RMB. Furthermore,

Table 9 Representativeness of the 16-province sample: summary statistics, 2005 census

Year 2005 variable	Minimum/Average wage			Employment/Population		
	All provinces	16 provinces (in our sample)	15 provinces (not in our sample)	All Provinces	16 provinces (in our sample)	15 provinces (not in our sample)
All	.388	.371	.425	.779	.783	.773
	(1.081)	(.087)	(.098)	(.087)	(.082)	(.093)
Gender						
Male	.361	.347	.398	.849	.852	.841
	(.082)	(.074)	(.089)	(.068)	(.058)	(.079)
Female	.432	.421	.470	.711	.719	.696
	(.098)	(.088)	(.102)	(.081)	(.074)	(.092)
Region						
East	.373	380	.461	.824	.841	.799
	(.067)	(.069)	(.100)	(.077)	(.072)	(.087)
Central	.410	.413	.400	.757	.764	.736
	(.083)	(.073)	(.099)	(.079)	(.073)	(.092)
West	.406	.410	.403	.759	.763	.751
	(.103)	(.121)	(.102)	(.093)	(.090)	(.096)
Age cohort						
Age 15–29	.421	.411	.474	.487	.502	.434
Age 30–39	.370	.352	.409	.850	.874	.802
Age 40–49	.377	.363	.403	.867	.887	.832
Age 50–64	.371	.357	.401	.534	.563	.498
Educational attainment						
High school or below	.463	.455	.490	.775	.779	.767
Junior college	.288	.267	.337	.824	.824	.825
College or above	.189	.167	.257	.877	.877	.878
Observations	1,687,919	1,084,190	603,729	1,687,919	1,084,190	603,729

Standard deviations are in parentheses. The 16 provinces include Liaoning, Beijing, Shandong, Jiangsu, Shanghai, Guangdong, Heilongjiang, Shanxi, Henan, Anhui, Hubei, Jiangxi, Gansu, Chongqing, Sichuan, and Yunnan

the minimum wages of Fushun and Huludao cities increased from 400 to 480 RMB on January 1st, whereas that of Yingkou city increased from 380 to 480 RMB, that of Fuxin city increased from 350 to 420 RMB, and that of Tieling city increased from 380 to 420 RMB the following year. As such detailed minimum wage data by county are not readily available to the public, we took effort to collect the data by ourselves.

[7]We are aware that possible endogeneity of minimum wages may bias our results, especially in China the minimum wage standards are set by provincial governments, labor unions, and employer groups. Neumark and Wascher (2004) argue that the earlier evidence from Wages Councils in the UK (which did not find disemployment effects) is likely not true because a minimum wage is not enacted when the labor market is in trouble, which may lead us to expect fewer adverse effects. But, as will be shown in Sections 4.2 and 4.3, we find clear evidence that minimum wages in China have resulted in disemployment for the less skilled workers, women, and young adults; and conversely we do not find disemplyment effects for the more skilled and prime age workers. Such falsification test helps rule out the endogeneity issue unless we believe

that Chinese policymakers time their minimum wage increases to coincide with adverse shocks on less skilled labor markets only. In addition, our finding of strong wage effects for the less skilled worker, women, and young adults also helps dismiss such kind of endogeneity concern. Similarly, our falsification test also helps reduce the concern raised by Dube et al. (2010); Allegretto et al. (2011) that high-wage industries also experienced lower job growth after minimum wage increases, which is spurious.

[8]In other words, depending on whether one accounts for this issue, the difference can be substantial. For instance, the mean monthly minimum wages in Beijing and Shanghai were 651 and 767 RMB in 2004–2009; however, the average expenses of both social security payments and housing provident funds in Beijing and Shanghai are as high as 376 and 452 RMB over the same period, amounting to 58 and 59% of the nominal minimum wages, respectively. We discuss how we address this issue in the Section 3.1.

[9]There are 31 administrative units at the provincial level in China, including 22 provinces, 5 autonomous regions, and 4 municipalities; as of 2012, there are 2,862 county-level administrative units.

[10]Although we do not report the results of migrant workers in the paper, they are available upon request.

[11]This has affected compliance significantly. According to our calculation using 2002–2009 data, nationwide the share of workers who earn less than the minimum wage declined continuously, falling from 7.28 to 5.62% in the pre- and post-2004 periods (2002–2003, 2004–2009), respectively. In particular, the number decreased from 8.08 to 5.33% in the Eastern region between the same periods; whereas in the Central region, the number decreased from 6.19 to 5.46%.

[12]We have also calculated three violation indices introduced in Bhorat et al. (2013) which has the form of $V_\alpha = E\{[(mw - w)/mw]^\alpha\}$, where w denotes wage, mw is the relevant minimum wage, α is the index that concerns the depth of violation, and E is the expectation operator. As α increases, there is more weight on greater violations. We use $\alpha = 0$, 1, and 2 to represent the standard, the depth, and the severity measures of violation, respectively. In addition, we also compute the ratio V_1/V_0 as the percentage shortfall of the average wage of violated workers from the minimum wage. Take all regions over the 2004–2009 period for example, the estimates for V_0 and V_1 are .071 and .024, respectively. The V_1/V_0 ratio is .338, indicating that non-complying employers paid wages that were on average 34 percent short of the legislative minima. Overall, the results are consistent to the descriptive statistics in Table 3 and the results using the enforcement variable. We find that all indices show the violation decreases over time in the Eastern and Central regions of China, especially after 2004; while the Western region has relatively higher violation. The results are available upon request.

[13]Note that the UHS is not publicly available. The NBS allows limited access to the microdata up to 16 provinces under certain conditions for academic research. Despite that, the 16-province sample includes most economically important provinces in China. To check the representativeness of our 16-province UHS sample, we use the 2005 Census to compare descriptive statistics of the 16 sample provinces with the 15 provinces not in the sample. We discuss and show that the 16 sample provinces are quantitatively similar to all provinces in Section 4.5.2.

[14]In the original data, we are able to identify how many months a person works and record his/her monthly income and wages in a year. From 2002 to 2009, on average, 91 % of the workers have worked for 12 months in a year.

[15]Note that there was no minimum wage increase in 2009 because of the Great Recession.

[16]For example, if the minimum wage adjustment in a particular county and a particular year took place on September 1, the mean minimum wage for that year and county is an average of the old and the new minimum wages, weighted by three-fourths and one-fourths, respectively. This time-weighted average method is used for our study because the adjustment date varies substantially across county and year in China. It can be in March, May, July or November (sometimes in January). This method helps reduce the bias from using all the old or the new minimum wage.

[17]In fact, the average real minimum wage has also grown at a similar rate. The mean changes in minimum wage are weighted by county worker population.

[18]The average annual growth rate of the minimum wage is 12.7% in the Eastern region, 13.2% in the Central region, and 12.5% in the Western region over the 2004–2009 period.

[19]Note that the minimum wage standards are the same for men and women.

[20]To assure that we are comparing minimum wage standards on a comparable basis, the minimum-to-average wage ratios in Table 2 have accounted for the fact that some provinces include social security payments and housing provident funds as part of the wage when calculating minimum wages. For example, the minimum wages in Beijing, Shanghai and Jiangxi do not include social security payments and housing provident funds, and the minimum wages in Jiangsu began to include only social security payments (but not housing provident funds) on November 1st, 2005.

[21]Our estimate of few full-time workers in China earn less than the monthly legal minimum wage is similar to Ye et al. (2014) that use a firm-employee matched data of 6 provinces in China and find the number is between 2.1 and 3.4% in 2009. The other estimate is by Sun and Shu (2011) who use a dataset of in 9 cities of Guangdong province in 2006, 2008, 2009 and 2010 and find that the proportion of rural-migrant workers who earn less than the monthly minimum wage in the four years is 9.0, 7.7, 4.0 and 4.2%, respectively.

[22]Note that Dube et al. (2010); Allegretto et al. (2011) have criticized the state/county panel-data approach and attempt to construct better counterfactuals for estimating the effects of minimum wages on employment. However, Neumark et al. (2014) provide evidence that the methods advocated by the above two studies do not isolate more reliable identifying information (or even throw out much useful and potentially valid identifying information), leading to incorrect conclusions. A recent paper by Meer and West (2013) who use three separate state panels of administrative employment data and find that minimum wages reduce net job growth. They show that the disemployment effects are most pronounced for younger workers and in industries with a higher proportion of low-wage workers. Although we don't anticipate the issues raised by Dube et al. (2010); Allegretto et al. (2011) would undermine our results, further work would be useful and our data permit researchers to explore additional issues.

[23]We present the results of the minimum wage effect on wages by age cohort, educational attainment, and the enforcement of minimum wage effects on wages in Additional file 1: Tables S1 to S3, respectively.

[24]We also show results for a high skill group (defined as workers with a college degree or above) as a placebo test in Section 4.3.

[25]Because the number of workers aged 15–19 is relatively small in our sample, we use the group of workers aged 15–29 to represent young workers.

[26]The working population defined in our analysis so far excludes the self-employed. That is, we focus on wage employees only. However, there are some concerns that by excluding the self-employed, the estimations may actually capture the effect of minimum wages on the structure of employment (wage versus self-employed) rather than on the share of people actually working. In response to the concerns, we re-examine the effects based on a broader definition of workforce by including the self-employed. Overall, our results are similar to Table 5 in that minimum wage changes result in statistically significant disemployment effects for young adults, at-risk groups, and the entire sample in the East, Central, and all regions over the same period of analysis. Likewise, we do not find any effect in the West. The results are available upon request.

[27]Over 2004–2009, 42% of young adults work in the state-owned enterprises in the Eastern region; 59 and 61% of young adults work in the state-owned enterprises in the Central and Western regions, respectively. For at-risk groups, 24% of them work in the state-owned enterprises in the Eastern region, while 43 and 47% work in the state-owned enterprises in the Central and Western regions, respectively.

[28]It is important to recognize that the UHS is designed to be representative at the provincial level, not at the county level. Due to random sampling errors, our samples for some specific counties may be noisy. To address this concern, we re-examine our main results in Table 5 at the provincial level. Similar to the results at the county level in Table 5, the provincial level estimations do not alter our findings. Minimum wage increases continue to have significant disemployment effects on the three groups in the East, Central and all regions, but no effect in the West.

[29]Indeed, our sample shows that the three groups are different in terms of employment type, skill, and wage distribution. Over the period of 2004–2009, less than 3% of young adults are in at-risk groups in each region. Likewise, less than 3% of at-risk groups are young adults in each region.

Additional file

Additional file 1: Table S1. Estimates of Minimum Wage Effects on Wages by Age Cohort. **Table S2.** Estimates of Minimum Wage Effects on Wages by Educational Attainment. **Table S3.** Estimates of Effects of the Minimum Wage Enforcement on Wages. **Table S4.** Estimates of Effects of the Minimum Wage Enforcement on the Employment-to-Population Ratio. (DOCX 88 kb)

Competing interest
The IZA Journal of Labor Policy is committed to the IZA Guiding Principles of Research Integrity. The authors declare that they observed these principles.

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and Employment in China, Hong Kong, and the World at The Hong Kong University of Science and Technology. All errors are our own.
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